

THE POLLINATION OF *GOODENIA CYCLOPTERA*.

(N.O. GOODENIACEÆ.)

BY ARCHDEACON F. E. HAVILAND.

Plate xciii.

Goodenia cycloptera R.Br., in the State of New South Wales, is generally confined to the Western Plains. It is a decumbent species, having axillary flowers furnished with indusia to the styles, and with auricles to the upper lobes of the five-partite corolla. These auricles are sufficiently induplicated to form a pocket into which the indusium, at a certain stage, becomes intruded, as explained below. As appears to be the case in other decumbent species, the indusium is inflected into the auricles, whereas, in erect species, it appears that the indusium remains erect, and the auricles press down over it.

The pollination and fertilisation of certain species of *Goodenia* have frequently engaged the attention of botanists, with occasionally dissimilar results; and I may specially mention, among the workers on the Australian flora in this connection, the labours of the late E. Haviland, F.L.S., and Mr. A. G. Hamilton. Both authors had treated of different species of *Goodenia*, and with the following results, which are of interest to this paper. Mr. E. Haviland, writing of *G. ovata*,* in the year 1884, observes—“The stigma covered by the indusium has re-entered [the corolla] through the passage by which it had passed out, the division of the upper lobe”; and, after referring to the ciliated indusium as being intended to brush the pollen off an insect visiting the flower, came to the conclusion that the flowers are cross-fertilised. I compare this with the observations noted by Mr. A. G. Hamilton† in the year following the above, and who says, of *G. hederacea*, that “the basal portion of the style is bent upwards so as

* These Proceedings, ix., 449.

† *Op. cit.*, x., 157.

to protrude the indusium through the slit between the two upper lobes of the corolla"; and, then remarking that the indusium re-enters the corolla, came to the conclusion that this species is self-fertilised. But he records the remarkable feature, that "the same set of organs which, in *G. ovata*, prevent self-fertilisation, in *G. hederacea* ensure it."

Now, if this divergence in the mode of pollination and fertilisation in these two species has been rightly decided by these two careful observers, one would be inclined to conclude, that *G. ovata*, being an erect, and *G. hederacea* a decumbent species, then other erect species of this genus would be likely to be cross-fertilised, and the decumbent species self-fertilised. I do not, however, find this to be the case in *G. cycloptera*, the decumbent species under consideration. In fact, in this species I find divergences from both the above species, as observed and noted by the authors mentioned; principally, in the fact, that they state the indusium, in both the species noted, exserts itself from the flower, and then, becoming inflected, re-enters it. In the case of *G. cycloptera*, I find that the style bends upon its ventral side, and thus protrudes its middle portion through the upper division of the corolla; but that the indusium, at the same time, and by reason of this exsertion, and aided also by the tendency of the corolla to bend back, presses hard against the auricles, which, by reason of their excessive induplication, are constitutionally enclosed well within the bases of the lobes of the upper part of the corolla. Hence, the indusium of *G. cycloptera* does not at any time protrude itself from the flower, as is stated to be the case in the species compared above.

Now, in inquiring further into the pollination of *G. cycloptera*, I think it will be found, contrary to the expectations expressed above, that, though it be a decumbent species, it is, after all, cross-fertilised. The method of pollination in this species may be thus stated. When the bud is but half-grown, the stamens are connivent around the style, with the base of the anthers just pressing against the indusium; the style at this stage develops rapidly—from observations most carefully made, I have calculated the rate of growth to be one line an hour—such a rapid move-

ment upwards irritates the anthers, causing them to dehisce, and the ciliated edge of the indusium, in passing, brushes the free pollen into its cup. The indusium, thus having outgrown the anthers, and being filled with pollen, becomes inflected against the induplicated auricles of the upper divisions of the corolla, as well as contracted at its mouth, thus locking up the pollen. By this action of the indusium, the upper portion of the middle of the style becomes dorsally exerted between the upper lobes of the corolla, and thus causes a false or premature opening of that part of the corolla; but, really, it is internally blocked by the induplicated auricles. This opening is apparently of no direct service in the pollination. I have noticed a "native Bee" visiting a flower at this stage, and trying to force its way through this false opening, but eventually giving up the struggle, and flying away.

The indusium, so far, contains the stigma, as yet rudimentary, in its base; and not till now does the flower open, having those limbs on the upper side and beyond the auricles, reflexed over the gynæcium; the indusium still pressing hard against the auricles, and beginning to re-open, and the three lower lobes of the corolla spreading platform-like, intimate to insects that all is ready for their kind offices. The stamens are withered and dejected, and the only entrance is along the lower limb, and then down the partially closed throat of the flower, where a little force is needed by the insect; but in doing so, the upper lobes of the corolla, with their auricles, become forced apart, exposing the mouth of the indusium, which is then brought into contact with the insect's back, and the pollen, if ripened sufficiently, which condition is intimated by the fact that the indusium has now re-opened, becomes brushed on to the back of the insect, by the ciliation of the indusium. Thus, also, is seen that this ciliation is for the double purpose of brushing in the pollen from the stamens, and again brushing it on to the insect.

From many observations, I have noticed that, as soon as the indusium becomes completely inflected, the stigma, which hitherto had remained rudimentary at the base of the indusium, begins to develop rapidly in the form of a two-lobed tuberculated body,

and does not become viscid till it has exceeded the edge of the indusium. All this time, prior to its viscosity, it has been pressing out the ripened pollen, and has become quite free from this load before it becomes viscid. Another insect visits the flower, and, probably, brings along some pollen from a previously visited flower; and, on entering the same central passage, gets the pollen brushed off its back by the ciliated indusium and on to the viscid surface of the stigma.

From these observations, it is hardly possible to draw any other conclusion than that the flowers of *G. cycloptera* are cross-fertilised. To satisfy myself further on this point by practical means, I tied some gossamer-bags over several bunches of flowers in the open bush-lands, where they would have every chance from natural causes, and watched for results; in every case, the ovaries withered, and fell off the peduncles with the flowers. In no case was there a single ovary or ovule developed; while the ovaries of the neighbouring flowers were developed and bore seeds. From the fact that these flowers were enclosed, not singly, but in bunches of three or four, in the bags, it would appear that not only are the flowers of this species cross-fertilised, but, also, that there is ground for very strongly suspecting that the pollen of one flower does not fertilise the ovules of another flower of the same plant; and this seems the more reasonable on account of the flowers being protandrous. This question, however, I leave till further opportunities of observation offer.

EXPLANATION OF PLATE XCIII.

- Fig.1.—Upper part of corolla, and two stamens removed, to show method of collecting pollen.
- Fig.2.—Same, but after stamens have withered, and the indusium has become filled with pollen.
- Fig.3.—Bud shortly before opening, to show bending of style and corolla apart, and the former becoming exerted.
- Fig.4.—Same, with portions removed to show the indusium pressing against the auricle of the remaining lobe. One auricle removed.
- Fig.5.—Flower with sides removed, to show the action of an insect in forcing itself under the indusium. (This was caught *in situ*).

(Figs.1-4 much enlarged.)